

***Astyanax pynandi* sp. n. (Characiformes, Characidae) from the Esteros del Iberá wetland, Argentina**

Jorge R. CASCIOTTA¹, Adriana E. ALMIRÓN¹, José A. BECHARA²,
Juán P. ROUX² & Federico RUIZ DIAZ²

¹ División Zoología Vertebrados, Facultad de Ciencias Naturales y Museo de La Plata, UNLP, Paseo del Bosque, 1900 La Plata, Argentina.

E-mail: jrcas@museo.fcnym.unlp.edu.ar

² Instituto de Ictiología del Nordeste, Facultad de Ciencias Veterinarias, UNNE, Sargento Cabral 2139, 3400 Corrientes, Argentina.

***Astyanax pynandi* sp. n. (Characiformes, Characidae) from the Esteros del Iberá wetland, Argentina.** - *Astyanax pynandi* is described from the Esteros del Iberá, one of the major wetlands in South America. *Astyanax pynandi* bears hooks on all fin rays of males, such as in *A. troya* and *A. ojiara*. *Astyanax pynandi* is distinguished from the remaining species of the genus by the following combination of characters: one maxillary tooth with 5 or 7 cusps; teeth of inner premaxillary row expanded distally; low dentary, bearing 8 teeth decreasing in size anteroposteriorly; 34-37 perforated scales in lateral series; 6-7 upper transverse scales; iii-v, 21-26 anal-fin rays; orbital diameter (36.7-43.5% of HL); postorbital length (37.0-44.7% of HL); and peduncle length (32.3-37.7% of HL). One humeral spot vertically elongated, bounded by a light area, and a second lateral spot faint or well developed.

Key-words: Characiformes - Characidae - *Astyanax* - Esteros del Iberá wetlands.

INTRODUCTION

The Esteros del Iberá is a wetland complex situated between the Paraná and Uruguay rivers in the north-east of Argentina. The Esteros del Iberá spreads about 12,000 km² and are fed exclusively by rainwater. This environment is one of the most important sources of pure water in South America (Neiff, 1997). Since 1983, it is a Provincial Reserve and in January 2002 part of this area was included in the Ramsar List of Wetlands of International Importance (Ramsar, 2003).

The Esteros del Iberá are included in the zoogeographic Brazilian subregion, the richest in South America with about 3,000 fish species (Arratia, 1997). In Argentina, the Brazilian subregion includes about 330 species, many of them restricted to the north and the east of the country (Almirón *et al.*, 1997), i.e., the area where the Esteros del Iberá are situated. Most of characiform fishes inhabiting these wetlands are members of the family Characidae (Casciotta *et al.*, 2003). Within this family, the

genus *Astyanax* is represented only by *Astyanax asuncionensis* Géry, 1972, *A. cf. fasciatus* (Cuvier, 1819), and *A. pynandi* sp. n. described below.

MATERIAL AND METHODS

The specimens examined in this study were cleared and counterstained (C&S) following Taylor & Van Dyke (1985). Measurements are straight distances taken with calliper to the nearest 0.1 mm. Peduncle length is the distance between last branched anal-fin ray and hypural joint. Vertebral counts include Weberian apparatus and CUI+PU1 as one element.

Material is deposited in the Academy of Natural Science of Philadelphia, USA (ANSP); Asociación Ictiológica, La Plata, Argentina (AI); Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, Argentina (MLP); Museo Argentino de Ciencias Naturales Bernardino Rivadavia, Argentina (MACN-Ict); Muséum d'histoire naturelle, Genève, Switzerland (MHNG).

COMPARATIVE MATERIAL (SL in mm)

Astyanax abramis (Jenyns, 1842): MLP 9427, 2 ex., 102.0-113.0 mm, Argentina, Misiones, río Paraná. *Astyanax alburnus* (Hensel, 1870): MLP uncat., 5 ex., 40.5-47.2 mm, Uruguay río Yaguarón. *Astyanax alleni* (Eigenmann & McAttee, 1907): MLP 6774, 5 ex., 50.0-64.2 mm, Argentina, Santa Fe, Laguna Setúbal. *Astyanax asuncionensis* Géry, 1972: MLP 8660, 5 ex., 43.6-61.4 mm, Argentina, Santiago del Estero, Bañado de Añatuya. MLP 8844, 7 ex., 25.0-44.9 mm, Argentina, Formosa, río Bermejo basin, arroyo Mbiguá. *Astyanax eigenmanniorum* (Cope, 1894): ANSP 21627, paratypes, 2 ex., 42.5-49.4 mm, Brasil, Rio Grande do Sul; MLP 9160, 6 ex., 37.3-70.6 mm, Argentina, Buenos Aires, Río de la Plata basin, laguna de Los Talas. MLP 2494, 13 ex., 30.0-53.1 mm, Argentina, Córdoba, río Quinto, Barreto. MLP 5202, 5 ex., 56.5-68.5 mm, Argentina, Córdoba, río Primero frente a Capilla de los Remedios. *Astyanax cf. fasciatus* (Cuvier, 1819): MLP 7115, 1 ex., 47.8 mm, Argentina, Santa Fe, río Paraná basin, San José del Rincón. MLP 8647, 5 ex., 34.0-45.8 mm, Argentina, Santiago del Estero, río Salado. *Astyanax leonidas* Azpelicueta *et al.*, 2002: MLP 9580, holotype, 45.6 mm, Argentina, Misiones, río Paraná basin, headwaters of arroyo Uruguay-í. *Astyanax ojiara* Azpelicueta & García, 2000: MLP 9470, holotype, 50.5 mm, Argentina, Misiones, arroyo Benítez. *Astyanax troya* Azpelicueta *et al.*, 2002, MACN-Ict 8310, holotype, 73.8 mm, Argentina, Misiones, arroyo Cuñapirú Chico.

Cleared and stained material (Personal collection of JRC): *Astyanax abramis*: 2 ex., 74.5-92.0 mm, Argentina, Buenos Aires, Río de la Plata in Punta Lara; 2 ex., 80.6-98.8 mm, Argentina, Misiones, río Piray-Mini, 2 ex., 62.4-72.9 mm, Argentina, Corrientes, río Riachuelo. *Astyanax asuncionensis* Géry, 1972: 2 ex., 28.0-37.6 mm, Argentina, Santa Fe, Isla Los Sapos; 2 ex., 80.4-92.7 mm, Argentina, Misiones, río Uruguay in San Isidro. *Astyanax eigenmanniorum*: 2 ex., 17.7-33.0 mm, Argentina, Buenos Aires, desembocadura del río Colorado; 2 ex., 28.0-30.5 mm, Argentina, Buenos Aires, Laguna de Gómez; 1 ex., 60.3 mm, Argentina, Buenos Aires, Río de la Plata; 1 ex., 45.0 mm, Brasil, Rio Grande do Sul, Viamão, açude Charolês. *Astyanax cf. fasciatus*: 2 ex., 91.0-106.5 mm, Argentina, Misiones, río Uruguay in San Isidro. *Astyanax leonidas*: 6 ex., 33.0-45.6 mm, Argentina, Misiones, río Paraná basin, headwaters of arroyo Uruguay-í. *Astyanax ojiara*: 10 ex., 37.8-58.0 mm, Argentina, Misiones, arroyo Benítez. *Astyanax troya*: 3 ex., 76.0-81.5 mm, Argentina, Misiones, río Paraná basin, arroyo Cuñapirú chico. *Astyanax paris*: 4 ex., 66.2-68.5 mm, Argentina, Misiones, río Uruguay basin, head-water of arroyo Yabotí Guazú, Arroyo Fortaleza.

RESULTS

Astyanax pynandi sp. n.

Figs 1-7, Tables 1-2

Holotype. MACN-Ict 8543, 52.0 mm SL, Argentina, Corrientes, Esteros del Iberá, Laguna Iberá, Lobo-Cuá (28°32'S-57°12'W), coll. J. Casciotta, J. Bechara, and P. Roux, July 2000.

Paratypes. MHNG 2640.34, 4 ex., 41.1-49.7 mm SL, collected with the holotype. AI 104, 4 ex., 48.9-54.3 mm SL, Argentina, Esteros del Iberá, Laguna Iberá, small canal close to house of park rangers (28°32'S-57°11'W), coll. J. Casciotta and A. Almirón, September 2002. AI 105, 1 ex., 36.2 mm SL, Argentina, Corrientes, Esteros del Iberá, Laguna Paraná-Canal Carambolas (28°15'S-57°26'W) coll. J. Casciotta and A. Almirón, September 2002. AI 106, 3 ex., 35.0-44.6 mm SL, Argentina, Corrientes, Esteros del Iberá, natural channel close to Laguna Sucia or Yacaré (Canal Pirayú, 28°44'S-58°02'W) coll. J. Casciotta, A. Almirón, and J. Bechara, July 2001. AI 115 1 ex., 35.1 mm Argentina, Corrientes, Esteros del Iberá, Laguna Paraná, collected below "embalsado" (28°20'S-57°30'W) coll. J. Casciotta, A. Almirón, and P. Roux, September 2002.

Diagnosis. The species is distinguished by the following combination of characters: one maxillary tooth with 5 or 7 cusps; teeth of inner premaxillary row expanded distally, low dentary bearing 8 teeth decreasing in size anteroposteriorly; males with hooks in all fins: 34-37 perforated scales in lateral series; 6-7 upper transverse scales; iii-v, 21-26 anal-fin rays; orbital diameter 36.7-43.5 (in % of HL); post-orbital length 37.0-44.7 (in % of HL); peduncle length 32.3-37.7 (in % of HL). One humeral spot vertically elongated, bounded by a light area; a second lateral spot may be faint or well developed.

Description. Morphometrics of holotype and paratypes are presented in table 1. Maximum body depth at dorsal-fin origin (Fig. 1). Dorsal profile of body slightly convex on snout, concave over eye and supraoccipital region, gently curved from supraoccipital area to origin of dorsal fin, slanted ventrally from dorsal-fin origin to caudal peduncle, almost curved in some large specimens. Dorsal profile of caudal peduncle scarcely concave; ventral profile concave. Ventral profile of body curved from tip of lower jaw to pelvic-fin origin, straight between pelvic fin and anal-fin origin, and slightly slanted dorsally to caudal peduncle. Body rounded between pectoral and pelvic fins; body laterally compressed between pelvic and anal fins.

Dorsal-fin origin almost equidistant from tip of snout and base of caudal fin. Pelvic-fin origin anterior to vertical through dorsal-fin origin. Adipose fin small, anterior to base of last branched anal-fin rays. Tip of pectoral fin reaching or very close to pelvic-fin origin; tip of pelvic fin not reaching anal-fin origin.

Dorsal fin with ii,8-9 rays (holotype = ii,9); posterior margin of dorsal fin straight, last unbranched and first branched dorsal-fin ray longest. In males, tip of dorsal-fin rays, with very small and slender hooks on first six unbranched rays, one pair on each segment, until 5 pairs on each ray.

Anal fin with iii-v, 21-26 rays (holotype = iii,24). Males with posterior margin almost straight; females with last unbranched and five or six branched rays produced forming a small lobe. Anal fin of males bearing small hooks on last unbranched and sixteen branched rays, directed outward and curved dorsally; one pair of hooks on each segment, until 11 pairs on each ray.

One unbranched and 9 branched principal caudal-fin rays in upper lobe; 8 branched and 1 unbranched principal rays in lower lobe; lower lobe slightly longer. Males, with few very slender hooks occurring on distal tips on middle caudal-fin rays.

Pectoral fin with i,11-13 rays (holotype = i,12). Posterior margin of pectoral fin rounded. Few very small and slender hooks on tips of three or four first branched rays in males.

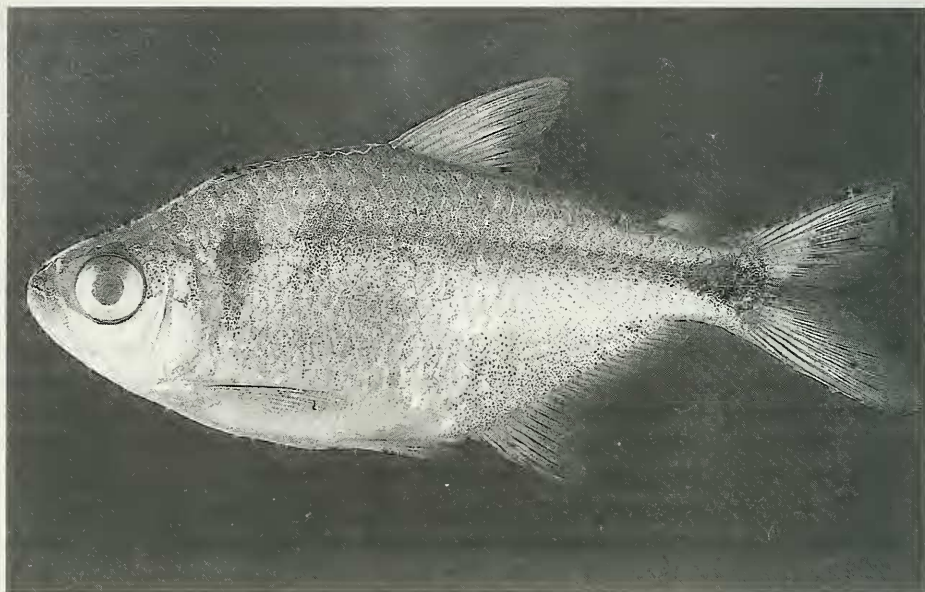


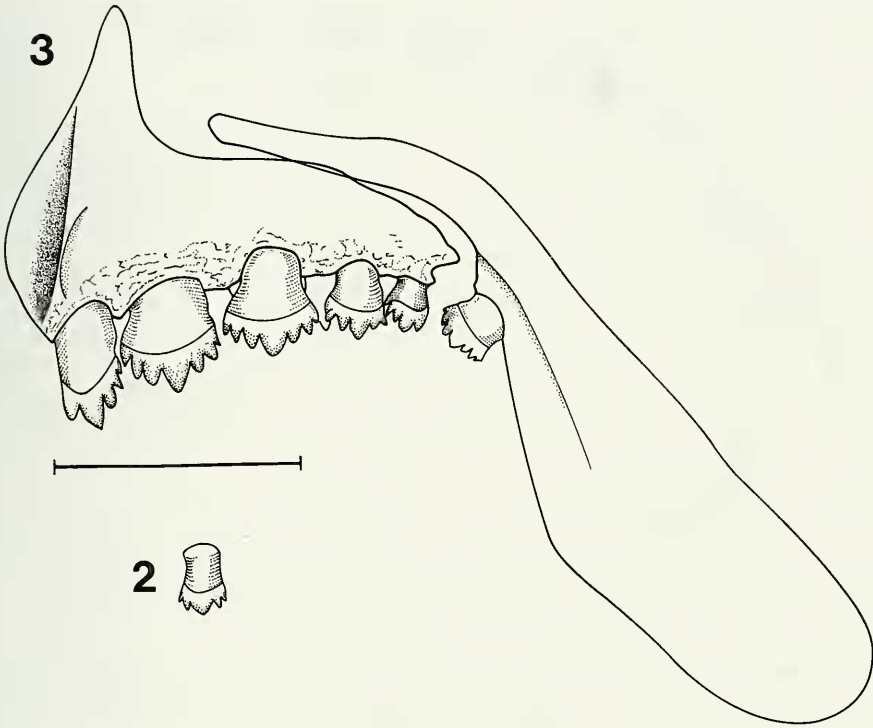
FIG. 1

Astyanax pynandi sp. n., holotype: MACN-Ict 8543, 52.0 mm SL, Argentina, Corrientes, Esteros del Iberá, Laguna Iberá, Lobo-Cuá.

Pelvic fin with i,7 rays, posterior margin of fin slightly rounded. Males with hooks on branched rays. One pair of hooks on each segment, few pairs on each ray, curved dorsally.

Head length less than 1/3 of SL, mouth terminal, horizontal; snout short. Lower and upper jaws equal in length. Premaxilla with 2 series of teeth, each tooth with a central cusp larger. Outer row with 3 to 4 teeth with 4 to 7 cusps, usually 5 (Fig. 2). Inner series of premaxilla with 5 teeth very expanded distally; symphyseal tooth slender, with 5 cusps; remaining teeth with 5 to 8 cusps (Fig. 3), central cusp scarcely longer than the others. Maxilla with long anterodorsal and laminar processes, the last one surpassing vertical through anterior orbital margin. One maxillary tooth with 5 to 7, usually 7 cusps (10 ex. and holotype); similar in shape to those of inner series of premaxilla (Fig. 3). Dentary low, with 8 teeth decreasing in size anteroposteriorly. Symphyseal tooth and the remaining 4 with 5 or 7 cusps, sixth and seventh teeth with 3 cusps, and eighth tooth unicuspidate (Fig. 4).

Eye large, interorbital area convex. Third infraorbital not reaching sensory tube of preopercle. Lateral series with 34-37 perforated scale (1 ex. = 34, 1 ex. = 35, 10 ex. = 36, 1 ex., holotype = 37); lateral line running on lower half of caudal peduncle. Six or 7 scales between dorsal-fin origin and lateral line; 5 or 6 scales between lateral line and ventral-fin origin. Ten to fourteen scales between supraoccipital process and dorsal-fin origin. Six to thirteen rectangular scales placed on anal-fin base, covering all unbranched and eleven branched anal-fin rays. Scales covering basal fifth of caudal lobes. Pelvic axillary scale without hooks on its posterior area in males.



FIGS 2-3

Astyanax pynandi sp. n.: 2, detail of last tooth of outer premaxillary series in labial view; 3, right upper jaw in lingual view. Scale = 1 mm.

Osteological characters: In one cleared and stained specimen, first arch bearing 17 gill-rakers: 3 on hypobranchial, 1 on cartilage, 9 on ceratobranchial, and 4 on epi-branchial. Vertebral counts: 35 vertebrae (16 precaudal + 19 caudal).

Coloration upon capture: Upper half of body darker, wide lateral band gray ending in a caudal spot, lower half silvery. Basal half of caudal lobes red, middle caudal rays faint gray, caudal fin margin hyaline or black. Base of anal fin red of faint red, and most specimens with anal-fin margin black. Pelvic fin redish near its origin.

Color of alcohol preserved specimens: Background pale brown, dorsal region of flanks and head darker, one dark midline along body on dorsum. Dark humeral spot vertically elongated, bounded by a clear area. Second lateral spot well developed or faint. Deep dark lateral band ending in a caudal spot.

Dorsal fin with black chromatophores on the unbranched rays, dark chromatophores on anterior and posterior margins of branched rays. Dorsal-fin membrane with chromatophores on its distal half. Large black chromatophores on distal margin of anal fin, forming a faint band in some specimens. Middle caudal-fin rays black; remaining caudal-fin rays with dark chromatophores on their margins. Pectoral and pelvic fins hyaline, few chromatophores along ray surfaces.

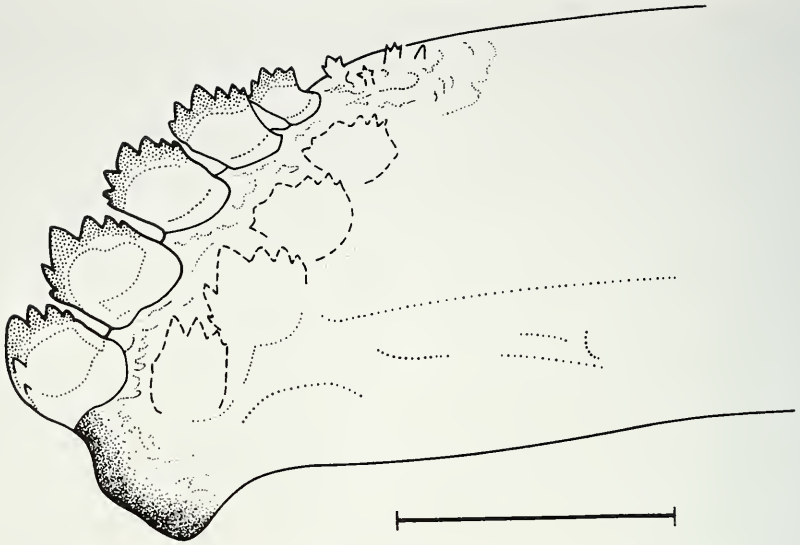


FIG. 4

Astyanax pynandi sp. n., right lower jaw in lingual view. Scale = 1 mm.

Chromatophores completely covering scales surface on upper half of flank, although leaving a marginal light area, forming a reticulate pattern; limit of scales bounded by black minute chromatophores. Scales on lower half of flanks with scattered chromatophores on their surface.

Dorsum of head black, also, premaxilla, dorsal half of maxilla, and middle lower jaw with numerous black chromatophores.

Sexual dimorphism. Males of *Astyanax pynandi* sp. n. have a body depth lower, pelvic fins and the anal-fin base longer, and the distance between pelvic and anal-fin origins shorter than those of females (table 1). Also they bear bony hooks on all fin rays, and have higher number of branched anal-fin rays (23-26 vs. 21-24 in females).

Etymology. The specific epithet *pynandi* is a guaraní word that refers to people without shoes, and was given in honor of the "descalzos" that every day struggle to recover their dignity in an unjust world.

Distribution. *Astyanax pynandi* sp. n. is known from the Laguna Iberá, Laguna Paraná, Canal Carambolas, and Canal Pirayú between Laguna Sucia or Yacaré and río Corriente (Fig. 5).

Habitat. *Astyanax pynandi* sp. n. was collected in littoral areas of both lentic and lotic waterbodies of Esteros del Iberá. Habitats were close to or surrounded by "embalsados", a local name given to thick (1-3 m) peat accumulations originated by incompletely decomposed aquatic plants such as *Typha* sp. and *Cyperus* sp. Masses of this tropical organic soils extend for thousands of kilometers, surrounding large shallow lakes connected by natural channels. "Embalsados" were deposited through thousands of years over sands, which were in turn transported by abandoned branches of the río Paraná.

TABLE 1. Morphometric data of the holotype and 13 other specimens of *Astyanax pynandi* sp. n.; minimum, maximum, and media between parentheses. Standard length expressed in mm.

	holotype	males	females
SL	52.0	35.1-49.7	36.2-54.3
Percents of SL			
Predorsal distance	53.5	51.5 - 55.8 (52.8)	50.8 - 55.2 (53.2)
Preventral distance	48.1	45.7 - 49.9 (47.6)	47.2 - 51.2 (49.3)
Preanal distance	65.4	61.6 - 67.5 (63.5)	65.3 - 69.7 (67.1)
Body depth	42.9	35.4 - 37.8 (36.4)	38.7 - 42.9 (40.3)
Dorsal-fin base	17.1	13.7 - 14.9 (14.5)	13.7 - 17.1 (14.8)
Anal-fin base	32.9	32.1 - 36.0 (33.7)	30.0 - 32.9 (31.6)
Pectoral-fin length	21.3	21.3 - 24.3 (22.5)	20.1 - 22.9 (21.6)
Pelvic-fin length	16.9	17.5 - 18.6 (18.1)	14.9 - 17.3 (15.9)
Distance between pectoral and pelvic-fin origins	22.5	20.0 - 22.8 (21.9)	20.7 - 23.8 (22.4)
Distance between pelvic and anal-fin origins	18.3	16.6 - 18.5 (17.6)	18.3 - 20.6 (19.7)
Head length	28.1	27.8 - 30.8 (28.7)	27.5 - 30.4 (28.8)
Peduncle depth	11.5	10.5 - 12.3 (10.8)	10.6 - 11.5 (11.0)
Percents of HL			
Peduncle length	36.3	32.7 - 34.8 (33.5)	32.3 - 37.7 (35.8)
Snout length	24.7	22.7 - 26.9 (25.2)	23.8 - 26.4 (25.2)
Eye diameter	38.4	39.1 - 43.5 (41.9)	36.7 - 41.7 (38.5)
Interorbital length	32.2	27.7 - 32.6 (30.4)	29.8 - 34.0 (31.5)
Postorbital length	42.5	37.0 - 42.2 (39.5)	39.9 - 44.7 (42.6)
Maxillary length	26.0	23.5 - 27.5 (25.6)	22.8 - 26.0 (24.8)

The main characteristics of the habitats are presented in table 2. In most cases, this species was found in transparent, brown coloured and slightly acidic waters. In addition, conductivity was more frequently below $20 \mu\text{S cm}^{-1}$, alkalinity between 5 and 10 mg l^{-1} , and oxygen saturation between 68 and 95%. Due to the dislodgment of peats, bottoms are muddy and organic, layered over the sand basement that can emerge in some areas.

The only exception to several of these features was the southernmost sampling site (Canal Pirayú, table 2, Fig. 5), close to río Corriente, which is the only superficial outlet of the wetlands. This site is in contact with soils containing higher salt contents, and receiving during summer poorly oxygenated waters from upstream wetlands.

REMARKS

Only two species of *Astyanax* were described having hooks on all fins of males, *A. ojiara* and *A. troya* (Azpelicueta & García, 2000; Azpelicueta *et al.*, 2002). *Astyanax pynandi* is similar to *A. troya* in many morphometric characters. However, *A. pynandi* is differentiated from *A. troya* in having longer anal-fin base (30.0-36.0 vs. 22.9-28.8 % of SL) and a higher number of anal-fin rays (iii-v, 21-26 rays vs. iv-v, 18-21). In addition, *Astyanax pynandi* has one, penta to heptacuspoid, usually heptacuspoid, maxillary tooth vs. one pentacuspoid in *A. troya*.

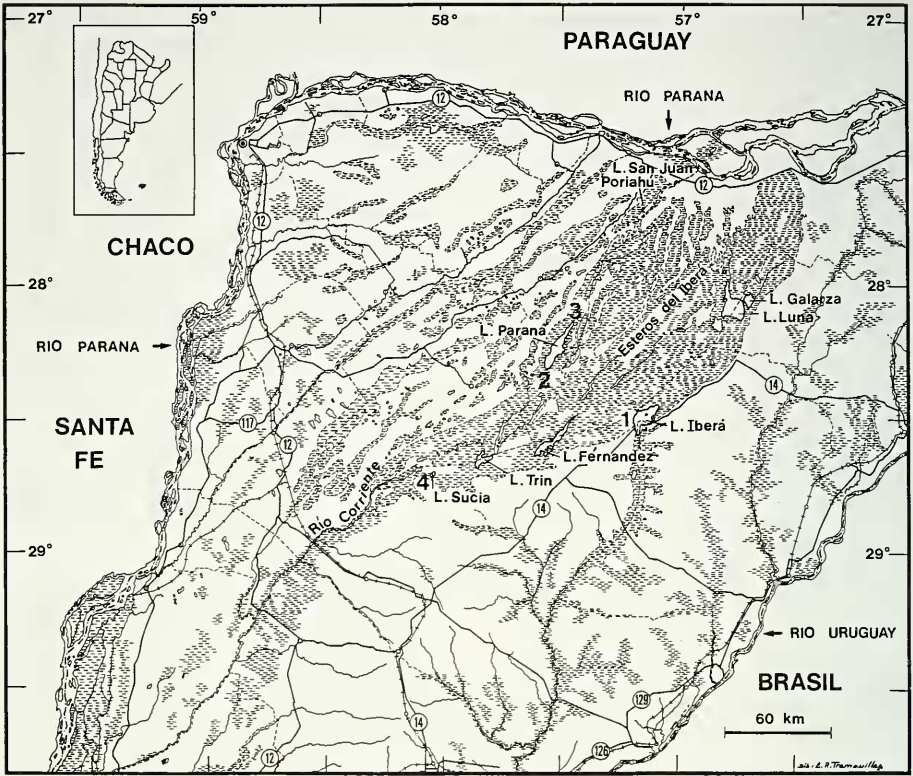


FIG. 5

Geographical distribution of *Astyanax pynandi* sp. n.: 1, Laguna Iberá (Lobo-Cuá and small canal close to the house of park rangers); 2, Laguna Paraná below of “embalsado”; 3, Laguna Paraná-canal Carambolas; 4, Laguna Sucia or Yacaré- canal Pirayu, río Corriente.

Astyanax pynandi is similar to *A. ojiara* in having one heptacuspoid maxillary tooth; also, they share the shape and number of premaxillary and dentary teeth, number of anal-fin rays and many morphometric characters. However *A. pynandi* is distinguished from *A. ojiara* in having lower dentary, less than 50% of lower jaw length (Figs 6-7); absence of hooks on the pelvic axillary scale, eye larger (36.7-43.5 vs. 29.1-37.2% of HL), postorbital shorter (37.0-44.7 vs. 50.0-57.2 % of HL); caudal peduncle length shorter (32.3-37.7 vs. 38.8-56.8% of HL); and greater number of upper transverse scale series (6-7 vs. 5).

Astyanax ojiara was described from the río Uruguay basin whereas *A. troya* comes from the río Paraná basin. *Astyanax pynandi* described herein is the third species with hooks on all fin rays of males and was found in the Esteros del Iberá which are part of the río Paraná basin. The water of the Esteros del Iberá comes exclusively from rainwater and it is only connected with the río Paraná basin through the río Corriente. The fish fauna inhabiting this wetland reaches 126 species and represents more than one third of freshwater fishes known from the Brazilian subregion in Argentina

TAB. 2. Description of some environmental variables of the habitat at the five sampling sites inhabited by *Astyanax pynandi* sp. n.

Sampling sites	Depth (m)	Bottom type	Water Temperature (°C)	pH	Conductivity ($\mu\text{S cm}^{-1}$)	Dissolved Oxygen (mg l^{-1})	D.O. (% saturation)	Secchi disk transparency (m)	Alkalinity (mg l^{-1})
Lentic habitats									
Laguna Iberá. Park rangers area.	0.6-0.9	muddy	24.3	5.8	16.1	6.49	79.0	0.6	7
Laguna Iberá. Lobo-Cuá area.	1.7	muddy	28.8	6.7	15.1	7.8	94.9	0.7	5
Laguna Paraná.	2.0	sandy and muddy	20.4	6.6	17.7	7.49	84.3	>2.0	6
Lotic habitats									
Canal Carambolas	3.5	sandy	21.5	6.4	19.9	6.03	68.2	>3.5	10
Canal Pirayú.	2.1	muddy	31.4	6.3	82.2	1.9	26.6	1.5	30

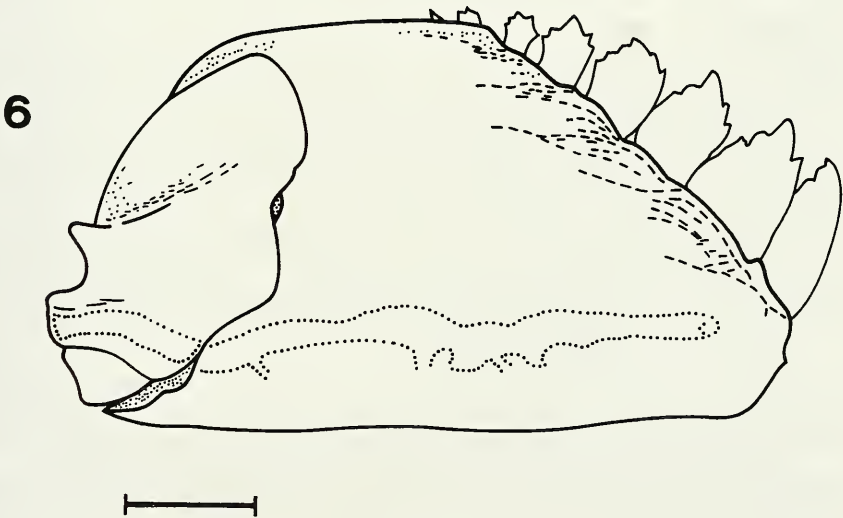


FIG. 6

Lower jaw, right external view, scale = 1 mm: *Astyanax ojiara*.

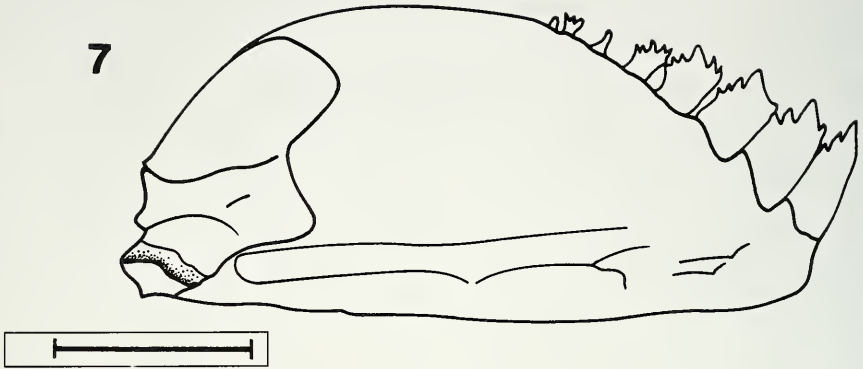


FIG. 7

Lower jaw, right external view, scale = 1 mm: *Astyanax pynandi* sp. n.

(Casciotta *et al.*, 2003). Although all of them are present in other river basins, *Astyanax pynandi* is at the moment the only endemic species in the Esteros del Iberá wetlands. Remarkably, it seems to prefer a distinctive and widespread habitat of these marshlands: the ecotone between “embalsados” and open waters.

ACKNOWLEDGEMENTS

We would like to express our gratitude to the partners of the INICNE (UNNE) and students of Facultad de Ciencias Naturales y Museo (UNLP) by their support in several activities during the field trips and to C. Tremouilles (UNLP) for help with figures. This project was financed by the National Geographic Society (Grant 7314-01) and Universidad Nacional del Nordeste (Grant).

REFERENCES

- ALMIRÓN, A. E., AZPELIQUETA, M. DE LAS M., CASCIOTTA, J. R. & LÓPEZ CAZORLA, A. 1997. Ichthyogeographic boundary between the Brazilian and Austral subregions in South America, Argentina. *Biogeographica* 73: 23-30.
- ARRATIA, G. 1997. Brazilian and Austral freshwater fish faunas of South America. A contrast (pp. 179-187). Proceedings of the International Symposium on Biodiversity and Systematics in Tropical Ecosystems. Bonn, 1994.
- AZPELIQUETA, M. DE LAS M. & GARCÍA, J. O. 2000. A new species of *Astyanax* (Characiformes, Characidae) from Uruguay river basin in Argentina, with remarks on hook presence in Characidae. *Revue suisse de Zoologie* 107: 245-257.
- AZPELIQUETA, M. DE LAS M., CASCIOTTA, J. R. & ALMIRÓN, A. E. 2002. Two new species of the genus *Astyanax* (Characiformes, Characidae) from the Paraná river basin in Argentina. *Revue suisse de Zoologie* 109: 243-259.
- CASCIOTTA, J. R., ALMIRÓN, A. E. & BECHARA, J. A. 2003. Los peces de la Laguna Iberá. *Editorial Al Margen, La Plata, Argentina*, 203 pp.
- NEIFF, J. J. 1997. Ecología evolutiva del Macrosistema Iberá (Corrientes, Argentina). *Tesis de Maestría en Ecología, Universidad Nacional del Litoral, Argentina*, 137 pp.
- RAMSAR. 2003. The Ramsar list of wetlands of international importance. The Ramsar Convention on Wetlands. <http://ramsar.org>
- TAYLOR, W. R. & VAN DYKE, G. C. 1985. Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. *Cybiurn* 9: 107-119.